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THE FACE OF THE EARTH.

The Face of the Earth (*Das Antlitz der Erde*). By Prof. Eduard Suess. Translated by Dr. H. B C. Sollas, under the direction of Prof. W. J. Sollas, F.R.S. Vol. i. Pp. xii+604; illustrated. (Oxford: Clarendon Press, 1904.) Price 25*s*. net.

ENGLISH-SPEAKING geologists will be grateful to Dr. Hertha Sollas and the Clarendon Press for this excellent translation of the first volume of the work which has probably had the deepest influence on geological thought since the publication of Lyell's "Principles." No higher compliment could be offered to such a book than that, twenty years after its publication, it should be worth while to issue a translation without amendment, comment, or other addition than the author's charming letter of introduction. This fact is all the more striking as this volume is mainly a description of the geology of the mountains of the world, and it describes areas of which comparatively little was known in 1884. As Prof. Suess remarks in his introduction, "the reader will meet here and there in the two first volumes with a description already antiquated." This matters the less since we have already an excellent French edition, which has been brought up to date by abundant references to recent literature, and been illustrated by an additional series of maps. The example of the French translators has not been followed, perhaps from the sentimental feeling that as this work is now one of the recognised classics of geology, it should be rendered into English exactly as it came from the hands of the master. This decision will no doubt increase the value of the Oxford edition to future geologists, though it may detract somewhat from its immediate educational usefulness. The absence of the extra maps is an especial drawback to British students, since many of the place-names used are synonyms or transliterations not usually adopted in British atlases. Anything that lessens the educational value of this edition is regrettable, as Suess's work is such magnificent educational material. Prof. Suess's method is to give the detailed evidence upon which he relies; and his readers have the pleasure of working up to the conclusions by the path the author trod. We see his mental process as well as read his results.

This volume opens with a brief statement of some of the geographical homologies which it is the object of the whole work to explain. Prof. Suess dismisses all geometrical plans of the earth, such as Elie de Beaumont's famous *Pentagonal reseau*, as misleading Wills-o'-the-wisp. He fully realises that the first essential to an explanation of the present distribution of oceans and continents is a competent comparison of the facts. As he says, a detailed comparison of observations is necessary before an attempt be made to formulate laws. Suess declines hints as to probabilities from geodesy, and he distrusts speculation as to the hidden parts of the earth. So he studies, with exquisite care, those deeper parts of the crust which have been brought to the surface in the exposed roots of mountains, or which are opened to view by the work of the miner. The two parts of this volume are devoted to a study of the movements in the crust of the earth, and to a description of the mountain system of the world, excluding Australia and some parts of other continents. Prof. Suess concludes from his synthetic study of this wide range of material that the earth's crust is disturbed by movements of two different kinds; firstly, the folding and crumpling of belts of the earth's crust by lateral pressure; and secondly, the foundering of the crust owing to the withdrawal of underground support, consequent on the radial contraction of the globe. Before Suess's time it was usual to regard the distribution of land and water as determined by the uplift as well as the sinking of wide regions. But according to Suess, regional uplifts have never yet been proved, and, excepting perhaps to some local extent, he regards them as impossible. An actual uplift of the surface of the western coast of South America was said to have resulted from the earthquakes of 1822 and 1835. The uplift of the latter was described by Darwin; but Prof. Suess discusses the evidence and dismisses it as wholly inadequate. Any horizontal uplift being, according to Suess, impossible where horizontal marine beds, beaches, or shore-lines occur above sea level, they must be explained by the lowering of the sea, and not by the uprise of the land. Prof. Suess does not hesitate to believe, on the evidence of the plateaus of the Rocky Mountains, that the sea level once stood 30,000 feet higher than at present. If Prof. Suess were to discuss the possibility of regional uplift at the present time, he would have to deal with much weightier evidence than any which he had against him in the year 1884. For the secular uplift of the lake regions of the United States is better established than any of the supposed earthquake elevations of Chili. Moreover, the doctrine of isostasy gives better reason to believe in its possibility. The pendulum work in the Rocky Mountains has rendered it at least possible, that isostasy may account for the horizontal deposits of the high plateaus, which Prof. Suess has described in one of the most brilliant chapters of this volume.

Regional uplifts, however, being dismissed by Prof. Suess, it follows that the main influence in shaping the continents has been the subsidence of wide tracts of the earth's surface beneath sea level. The great ocean basins, and those of the Mediterranean, the Black Sea, and the Caribbean Sea, represent sunken areas of the earth's crust; and foundering to a less depth has caused the rift valleys of Ethiopia, of the Rhine and of Australia, and the basins of Suabia and Franconia. The cause of such subsidences is deep-seated, whereas the crumpling of the long, narrow belts that form the folded mountain chains is due to comparatively superficial action. The two modes of movement may act in the same area at different times. Thus vertical subsidences may destroy the continuity of a folded mountain chain; thus the present form of the Basin Ranges of Utah and Nevada is due to the breaking up, by Cainozoic subsidences, of a series of ranges formed by earlier, post-Jurassic folds. Similarly the outlines of the continents even when

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dependent upon the course of mountain chains, are embayed where the sea has flowed over foundered blocks. The vertical relief of the continents is determined mainly by subsidences, by the resistance of great blocks of strata which remain as plateaus high above the general level of the country, and by the crumpling of bands into mountain chains. The course of such crumpled bands is very sinuous, because they have to adapt themselves to the passive resistance of stronger blocks of the crust; they curve round the margins of the resistant masses, on to the edges of which they may be overthrust. Suess follows, for example, the course of the great Alpine mountain system from its western end in southern Spain, through the Atlas Mountains of Africa, along the the Apennines through Italy, across central Europe as the Alps and Carpathians, and then through the great curve around western Roumania and Servia into the Balkans. Its continuity eastward has been broken by the recent foundering of the Black Sea; but the Alpine system is continued through the Crimea and the Caucasus, and after another gap, caused by the subsidence that formed the southern basin of the Caspian, it is continued across Asia through the Himalaya and the chains of Burma into the islands of Malaysia. Suess explains the sinuous course of this folded band by tracing its dependence upon the unfolded blocks, against which it has been pressed.

The theory of the permanence of oceans and continents inevitably receives slight consideration from Prof. Suess. He does not trouble us with the *a priori* arguments on this question. He simply tells us the contemporary evidence as to the actual age of the continents. Thus he points out that in the Cretaceous period North America was not; but it had come into existence at the beginning of the Laramie period, and has lasted ever since. Similarly the Indian peninsula and Africa south of the Atlas are remnants of the Mesozoic plateau-continent of Gondwanaland, which has been severed into two by the foundering of the Indian Ocean in late Cainozoic times.

Consideration of Prof. Suess's work inevitably suggests a comparison with that of Lyell. Suessism is sometimes regarded as a rival school to Lyellism. But Suess's essential doctrines are a development of Lyell's views rather than being in direct opposition to them. Lyell, for instance, attacked the belief that volcanoes are craters of elevation; but, in the necessary darkness of the days before Sorby's ingenuity had rendered microscopic petrology possible, he retained his belief in an axis of elevation for the mountain chains. Suess has now taught us that the axes of elevation of mountain chains must follow von Buch's craters of elevation of volcanoes. Even in regard to what is sometimes considered as Prof. Suess's arch heresy—his acceptance of great variations in the ocean level—he is opposed to ultra-Lyellists and not to Lyell. The following passage from the "Principles" shows that, with Lyell, Ordnance Datum was not a fetish:—

"This opinion is, however, untenable; for the sinking down of the bed of the ocean is one of the means by which the gradual submersion of the land is prevented. The depth of the sea cannot be increased at any one point without a universal fall of the waters, nor can any partial depositions of sediment occur without the displacement of a quantity of water of equal volume, which will raise the sea, though in an imperceptible degree even to the antipodes. The preservation, therefore, of the dry land may sometimes be effected by the subsidence of part of the earth's crust (that part, namely, which is covered by the ocean), and in like manner an upheaving movement must often tend to destroy land; for if it renders the bed of the sea more shallow, it will displace a certain quantity of the water, and thus tend to submerge low tracts."

One chief difference between Suess and Lyell is that Lyell was naturally inclined to exaggerate the importance of local earth movements. Prof. Suess, with the benefit of a much wider knowledge than was possible to Lyell, and equal intellectual insight, realises that the geological systems are defined, not by independent local movements, but by changes that are world-wide in scope. Suess's views are not essentially opposed to the uniformity, which Lyell established, in opposition to the preceding belief in catastrophes of extraneous origin. Suess and Lyell both teach us that geological changes are due to causes that are still in action. Geographical evolution, like organic evolution, has not been interrupted by external influences or unnatural catastrophes; but it does not necessarily follow that the rate of progress has been uniform. There have been periods of geographical revolution due to a rush of movements, that relieved stresses produced by long periods of slow change. Such disturbances affect the whole world; and it appears probable that the correlation of strata in distant regions will depend on palæontology only for general homotaxis, and on the events of physical geology for the determination of exact synchronism.

A second difference between Lyell and Suess is that the former attached a, perhaps, exaggerated belief to the importance of denudation in modelling the surface of the globe. His own studies lay in lands wherein denudation has been more powerful than recent earth movements. The sub-title of his "Principles"—"the Modern Changes of the Earth and its Inhabitants Considered as Illustrative of Geology"—shows his point of view. He taught men that the common geographical features of Europe and Eastern America were due to the long-continued operation of slow and still active forces; but he did not fully realise that, elsewhere, the major geographical features are the direct expression of recent disturbances of the crust.

As to the cause of the distribution of these disturbances Prof. Suess has not yet given us his full explanation, and in this volume he rightly held such questions premature. But it is now possible, mainly thanks to his work, to trace one controlling factor in the existing plan of the earth—the alternation of periods of spheroidal recovery due to the earth's rotation, with periods of deformation due to the shrinking of the earth's internal mass. This factor promises the clue to the periodicity of geological events, to the general world-wide correspondence in the geological formations, and to the distribution of the folded bands and foundered blocks of the earth's crust.

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